05-22-00 A

Atty. File # 5891

PATENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): J. Stuart Cumming

Title: LENS ASSEMBLY FOR DEPTH OF FOCUS

Enclosed are:

- ⊗ 4 sheets of drawings
- ⊗ Specification, Claims, Abstract, Declaration and Power of Attorney
- ⊗ 1 Verified Statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27
- ⊗ Information Disclosure Statement - Section 1.97(b); Form PTO-1449, and copies of all references cited therein.
- ○ This application is a continuation-in-part of application Serial No. _____, filed _____.
- ○ Disclosure Document No. _____ was filed on _____ on the invention of this application. Reference is hereby made to the filing of said Disclosure Document in accordance with MPEP 1706.

The filing fee has been calculated as shown below:

Eff: 12-29-99

			SMALL ENTITY			OTHER THAN A SMALL ENTITY	
FOR	NO. FILED	NO. EXTRA	RATE	FEE	OR	RATE	FEE
BASIC FEE				$ 345	OR		$ 690
TOTAL CLAIMS	30 -20=	10	x 9 =	$ 90	OR	x 18 =	$
INDEP CLAIMS	3 -3=	0	x 39 =	$ 0	OR	x 78 =	$
			TOTAL	$ 435	OR	TOTAL	$

⊗ A check in the amount of $ 435.00 to cover the filing fee is enclosed.

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date May 19, 2000 in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EK689926298US, addressed to the: Ass't Commissioner for Patents, Washington, D.C. 20231

Boniard I. Brown
Name of person mailing paper

Boniard I. Brown
Signature of person mailing paper

Respectfully,

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Applicant or Patentee J. Stuart Cumming Attorney's Docket No. 5891

Title: LENS ASSEMBLY FOR DEPTH OF FOCUS

Serial No. _____ Filed _____

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27(b)) - INDEPENDENT INVENTOR

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled LENS ASSEMBLY FOR DEPTH OF FOCUS described in

(X) the specification filed herewith

( ) application serial no. _____, filed _____

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an Independent Inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

(X) no such person, concern, or organization

( ) persons, concerns or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME _____

ADDRESS _____

( ) INDIVIDUAL ( ) SMALL BUSINESS CONCERN ( ) NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

J. Stuart Cumming
NAME OF INVENTOR

May 17, 2000
DATED

J. Stuart Cumming
SIGNATURE OF INVENTOR

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT J. STUART CUMMING, a citizen of the United States, residing at Laguna Beach, California, has invented a new and useful

LENS ASSEMBLY FOR DEPTH OF FOCUS

of which the following is a specification:

BACKGROUND AND SUMMARY OF THE INVENTION

The natural human lens provides only limited depth of focus, with clear vision only over a limited range of distance.

The present invention provides increased depth of focus by positioning an optic posteriorly in the eye by disposing it on a substantially rigid frame which is configurated to vault posteriorly, thus enabling accurate viewing over a wider range of distances with greater distance between the cornea and the optic, and the further posteriorly the positioning of the optic, the higher the power of the optic, and the less the lens movement required for a given power change.

The frame may preferably have plate haptics with transversely extending loops at the outer ends of the haptics to engage peripheral portions of the capsular bag of the eye and center the lens. The haptics may preferably be such as that shown and described in Applicant's Patent No. 6,051,024, "Intraocular Lenses with Fixated Haptics".

The optic utilized with the invention is substantially smaller than the natural human lens. Whereas the natural human lens is about 5.0 mm in thickness, an optic utilized with the invention may typically be 1.0 mm, and may range between 0.5 mm and 1.5 mm. The optic may preferably be similar to that shown and described in Applicant's application Ser. No. 09/370,235, "Lens For Increased Depth of Focus".

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view of a preferred embodiment of the invention disposed in an eye;

Fig. 2 is an elevational view of a frame utilized with the invention;

Fig. 3 is a sectional view taken at line 3-3 in Fig. 2;

Fig. 4 is an elevational view of an lens utilized with the invention and having extensions with transverse ridges thereon;

Fig. 5 is a side view of the lens of Fig. 4;

Fig. 6 is a sectional view taken at line 6-6 in Fig. 2;

Fig. 7 is an elevational view of the components of Figs. 2 and 4 in assembled relation;

Fig. 8 is a sectional view taken at line 8-8 in Fig. 7;

Fig. 9 is a sectional view, similar to that of Fig. 8, further showing a modified form with extending edge portions of haptics;

Fig. 10 is a sectional view of the lens in Fig. 5, extended and unassembled;

Fig. 11 is an elevational view of a modified form of the frame of Fig. 2;

Fig. 12 is a perspective view showing the lens assembly of Fig. 7 folded along its longitudinal axis;

Fig. 13 is an elevational view of a modified form of the lens assembly of Fig. 7;

Fig. 14 is a sectional view taken at line 14-14 in Fig. 13;

Fig. 15 is an edge view of the frame of Figs. 13 and 14;

Fig. 16 is an elevational view of the frame portion of the assembly of Fig. 13;

Fig. 17 is an exploded view of a frame with a modified lens wherein hand ridge portions thereof have passages therethrough for axial compression;

Fig. 18 shows a modified form of the lens assembly of Fig. 13;

Fig. 19 is an elevational view showing the frame component of the lens of Fig. 18;

Fig. 20 is an elevational view of a lens of the invention wherein frame members are joined with a web having an optic thereon;

Fig. 21 is a sectional view taken at line 21-21 in Fig. 20;

Fig. 22 is a perspective view of the lens of Fig. 20;

Fig. 23 is an elevational view of a modified form of the lens of Fig. 20, wherein oppositely extending web portions are bifurcated and engaged with the frame members;

Fig. 24 is a sectional view taken at line 24-24 in Fig. 23;

Fig. 25 is an edge side view of the lens of Fig. 23; and

Fig. 26 is a partial elevational view of a portion of the lens of Fig. 23, showing lug portions at the outer ends of a bifurcated web portion.

DESCRIPTION OF PREFERRED EMBODIMENT

The present invention provides increased depth of focus by providing a relatively rigid frame with haptics extending oppositely to engage a perimeter or equator of a capsular bag, and having a central opening to accommodate an optic engaged on the frame and movable anteriorly relative to the frame.

Referring to Figs. 1 to 8, frame 10 comprises a central portion 12 which defines a relatively large opening 14, and haptics 16, 18 extending oppositely from the central portion with fixation loops 20, 22 extending transversely from their outer portions, as shown, to engage peripheral portions of capsular bag 23. Slots 24, 26 extend from outer edges of the respective haptics and across a major width of each haptic.

A lens 30 comprises an optic 32 from which extend relatively short extensions 34, 36 which terminate in generally cylindrical ridges 38, 40. The ridges are adapted to be engaged and retained in the slots 24, 26, as shown in Figs. 7 and 8, wherein they are retained in position by shoulders 27 which define enlarged portions of the slots 24, 26 (Fig. 2).

In the modified form of Figs. 9 and 10, posteriorly extending frame portions or bumps 42, position the optic 32 further posteriorly than it would otherwise be, thus to effect additional, enhanced depths of focus, as will be understood from the geometry

of the components.

In Figs. 7, 8 and 9, the frame 10 and lens 30 are shown retained in assembled relation.

The optic 32 is thinner than a natural optic of a human eye and may have a thickness between 0.50 mm and 1.5 mm and may typically be about 1.0 mm thickness. The optic may typically be similar to that shown and described in the above-mentioned application of Applicant.

In operation, the optic 32 is movable anteriorly of the eye under vitreous pressure upon constriction of the ciliary muscle. The contraction of the muscle produces vitreous pressure which tends to urge the optic toward or into the hole 14 of the frame. The optic typically need not extend through the opening 14, but only extend about 1.0 mm into the opening. The optic need only move 1.0 mm to effect a change of 1.5 to 2.0 diopters of power change. The relatively rigid frame and the vitreous pressure thus effect optic movement relative to the frame.

It may be noted that an advantage of the present invention is that utilization of the relatively rigid frame substantially eliminates need for administration to a patient of a substance such as atropine during a period following surgery. This eliminates a problem in practice relative to patients not taking atropine, as instructed, during a period following surgery in order to maintain

the ciliary muscle in a relaxed condition during fibrosis relative to end portions of haptics.

The transversely extending loops 20, 22 provide centration and to facilitate fixation of the optic in the general manner described in Applicant's Patent No. 6,051,024, entitled "Intraocular Lenses With Fixated Haptics".

The frame 10 may typically be formed of PMMA, polycarbonate, nylon, other relatively rigid material, platinum or gold. The lens 30 may preferably be formed of a flexible optical material, such as silicone, acrylic, HEMMA, hydrogel, etc.

To provide for the bending or folding of the frame, as shown in Fig. 12, for insertion through a relatively short slit in the eye of a patient, the frame may be formed of relatively soft material at portions of the frame which are folded to provide a narrower configuration for insertion through the relatively short slit of the eye. These features include notches 46, 48 (Fig. 11) which extend from respective slots 24, 26 toward the opening 14 of the frame, and substantially reduced portions 50, 52 outwardly of the slots 24, 26.

Referring to Figures 13-17, a lens 54 has features in common with the embodiment of Figures 7-11, and differs in having enlarged openings 56, 58 of the configuration shown, wherein an enlarged rounded portion of the opening extends to define

relatively narrow haptic portions 60, 62 wherein slots 64, 66 are defined to receive ridges 38, 40, as with the embodiment of Figs. 7-11. The defining of the narrow haptics portions facilitates bending of the lens about its longitudinal axis (Fig. 12). Fig. 17 shows a partial, exploded view of this embodiment.

Figs. 18 and 19 show an embodiment similar to that of Figs. 13-17 but wherein there is no enlarged opening in haptics 68, 70.

Referring to Fig. 17, a modified form of the ridges 38, 40 at the ends of the optic extensions are hollow with passages 76, 78 therethrough, as shown in Fig. 17. As indicated in the figure, this type of ridge portion enables the ridge portion to be compressed by application of pressure to facilitate installation and retention of the ridge in a slit 64 or 66.

Figs. 20-26 illustrate embodiments in each of which relatively rigid frame members have attached therebetween a web whereon is disposed an optic.

Figs. 20-22 show an embodiment 80 wherein a web 82 is secured to opposite frame members 84, 85, as by integral molding of the components, by fasteners 86, or spot-welding. An optic 88 may typically be formed integrally with the web. The rigid frame members include transversely extending end loops 90, 92, as shown, for centration of the optic in the capsular bag of an eye.

Figs. 23-26 illustrate an embodiment wherein spaced-apart relatively rigid frame arms 96, 98 have attached thereto end portions of arms of webs 100, 102 which extend oppositely from a haptic 104. The webs are typically formed integral with the optic. The webs have retention knobs 110, 112 on their end portions (Fig. 26) to engage in slots 106, 108 in the frame arms to secure and retain the web portions relative to the frame members.

Figs. 24 and 25 are side views, taken respectively at lines 24 and 25 in Fig. 23, showing the particular manner in which the lugs 110, 112 engage in the slots 106, 108, and the relation of the optic to the frame members.

It will be understood that various changes and modifications may be made from the preferred embodiments discussed above without departing from the scope of the present invention, which is established by the following claims and equivalents thereof.

THE INVENTOR CLAIMS:

1. An intraocular lens assembly for increased depth of focus, comprising:

a frame having haptics extending oppositely to engage peripheral portions of a capsular bag, said frame being configurated to vault posteriorly in an eye of a person,

said frame having end portions to engage in the periphery of the capsular bag of an eye,

said frame defining a generally circular opening between inner portions of said haptics,

an optic sized and configurated to engage in an edge portion of said frame opening, and

interengaging features on the frame and on the optic for attachment of the optic to the frame for limited optic movement relative to the frame,

whereby light refracted by the cornea of the eye travels an increased distance to the optic to substantially increase depth of focus.

2. An assembly according to Claim 1, wherein:

said optic has a thickness substantially less than the thickness of a natural human optic.

3. An assembly according to Claim 3, wherein the optic is about 1.0 mm in thickness.

4. An assembly according to Claim 3, wherein the optic has a thickness between 0.5 mm and 1.5 mm.

5. An assembly according to Claim 1, wherein:

said interengaging features comprise transverse slots in the frame spaced oppositely from said opening, and mounting portions extending oppositely from the optic and having transverse ridges at end portions thereof for retention in the slots.

6. An assembly according to Claim 5, wherein at least one of said slots has a widened portion with slot end shoulders to retain at least one of said ridges for prevention of optic lateral movement.

7. An assembly according to Claim 6, wherein each of said slots has a widened portion with end shoulders to retain the optic against lateral movement.

8. An assembly according to Claim 1, and further including:

an edge portion of the frame about said frame opening extending posteriorly to engage the optic farther posteriorly.

9. An assembly according to Claim 6, and further including:

a notch extending from at least one of said slots adjacent to said frame opening to facilitate folding of the frame for insertion thereof through a slit in an eye.

10. An assembly according to Claim 6, and further including a notch extending from each of said slots toward said frame opening for facilitating the folding of the frame for insertion thereof through a slit in an eye.

11. An assembly according to Claim 6, wherein:

a portion of the haptic between each slot and said frame opening has a reduced longitudinal dimension to facilitate folding of the frame longitudinally for insertion of the frame through a slit in an eye.

12. An intraocular lens assembly for increased depth of focus, comprising:

a frame of generally rigid material and configurated to vault posteriorly in an eye of a person, said frame having haptics extending oppositely therefrom to engage peripheral portions of a capsular bag,

said frame defining a central generally circular opening,

said frame having transverse slots spaced oppositely from said frame opening, and

an optic adapted to be disposed adjacent said frame opening, said optic having mounting portions extending oppositely therefrom for engagement in said frame slots to retain the optic relative to the frame,

whereby light refracted by the cornea of the eye travels an increased distance to the optic to substantially increase depth of focus.

13. An assembly according to Claim 12, wherein:

said optic has a thickness substantially less than the thickness of a natural human optic.

14. An assembly according to Claim 13, wherein the optic is about 1.0 mm in thickness.

15. An assembly according to Claim 13, wherein the optic has a thickness between 1.5 mm and 1.5 mm.

16. An assembly according to Claim 12, wherein:

said optic mounting portions extending oppositely from the optic have transverse ridges at end portions thereof for retention in the slots.

17. An assembly according to Claim 16, wherein at least one of said slots has a widened portion with slot end shoulders to retain at least one of said ridges to retain the optic in position.

18. An assembly according to Claim 16, wherein each of said slots has a widened portion with end shoulders to retain the optic against lateral movement.

19. An assembly according to Claim 12, and further including:

an edge portion of the frame adjacent to said frame opening extending posteriorly to engage the optic farther posteriorly.

20. An assembly according to Claim 16, and further including:

a notch extending from at least one of said slots toward said frame opening to facilitate folding of the frame for insertion thereof through a slit in an eye.

21. An assembly according to Claim 16, and further including:

a notch extending from each of said slots toward said frame opening for facilitating the folding of the frame for insertion thereof through a slit in an eye.

22. An assembly according to Claim 16, wherein:

a portion of the haptic between each of said slots and said frame opening has a reduced longitudinal dimension to facilitate folding of the frame longitudinally for insertion of the frame through a slit in an eye.

23. An assembly according to Claim 12, wherein:

a loop portion extends from the outer end portion of each haptic and transversely of the lens to engage the peripheral portions of the capsular bag.

24. Apparatus according to Claim 12, wherein an enlarged opening is defined in each of said haptics, and extends into proximity with said slots to define a substantially narrow hinge portion to substantially narrow haptic portions to facilitate bending of the lens along its longitudinal axis.

25. An assembly according to Claim 12, wherein said mounting portions of the optic comprise ridges, and at least one of said ridges has a passage therethrough to facilitate insertion and engagement of the optic mounting portion in the slot.

26. An apparatus according to Claim 25, wherein each of the oppositely extending mounting portions has a passage therethrough.

27. An intraocular lens assembly for increased depth of focus, comprising:

a pair of relatively rigid spaced-apart frame members adapted for engagement with the periphery of a capsular bag of the eye, and

a web secured to and extending between said frame members and having thereon an optic,

said web being secured to the frame members by (a) integral molding with the frame members, (b) spot-welding, (c) fastener elements.

28. An intraocular lens assembly according to Claim 27, wherein said frame members have end loop portions extending oppositely and transversely to engage in the peripheral portion of the capsular bag.

29. An intraocular lens assembly according to Claim 28, wherein said loop portions are extensions of the frame members.

30. An intraocular lens assembly according to Claim 27, wherein:

the web has portions extending oppositely from the optics, and

said web portions being bifurcated and having lugs thereon,

said frame members having slits defined therein to receive the lugs of the web portions, and the lugs and loops being generally disposed equidistant from a center of the optic.

ABSTRACT

An intraocular lens assembly for increased depth of focus has a frame configurated to vault posteriorly in an eye and an optic attached thereto. Pressure from ciliary muscle contraction moves the optic anteriorly to focus the eye for near vision.

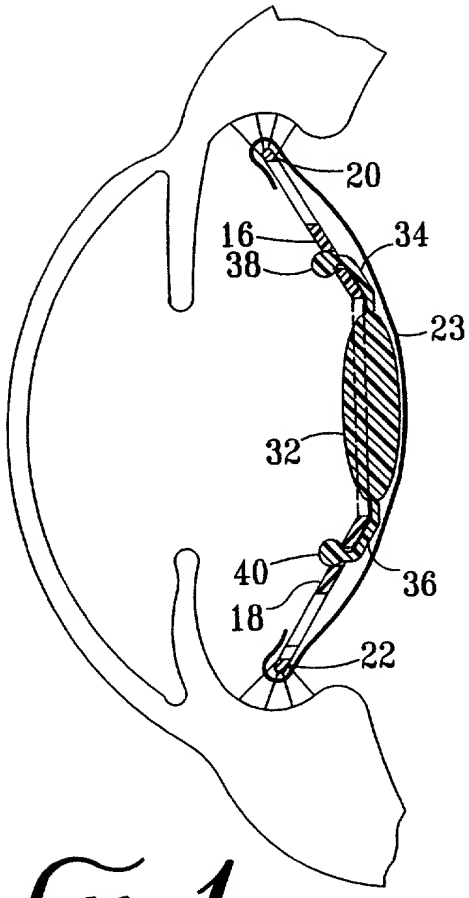

Fig. 1

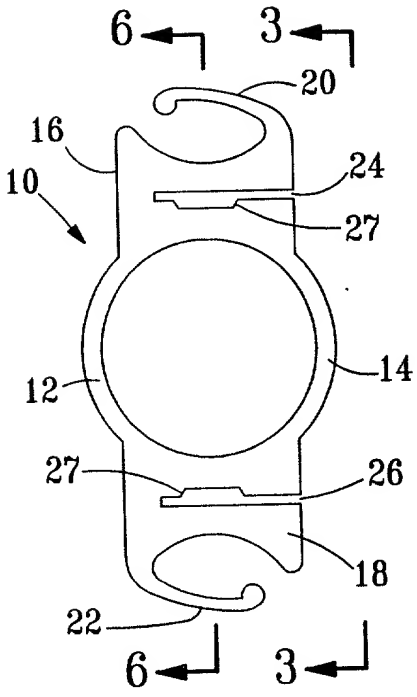

Fig. 2

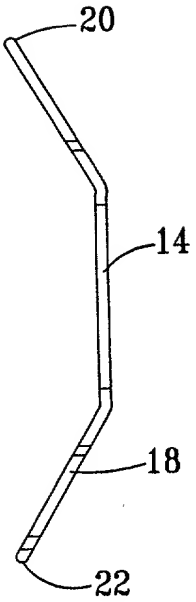

Fig. 3

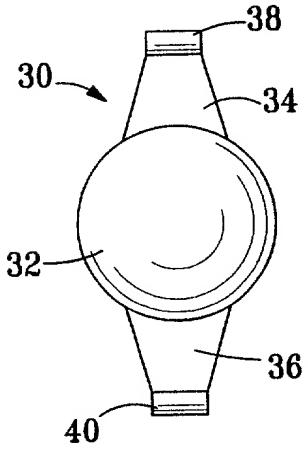

Fig. 4

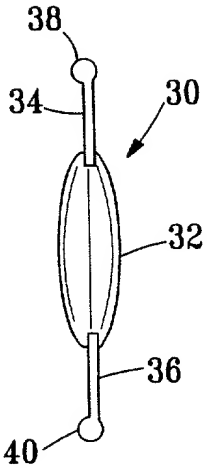

Fig. 5

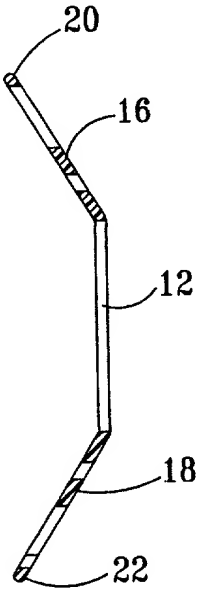

Fig. 6

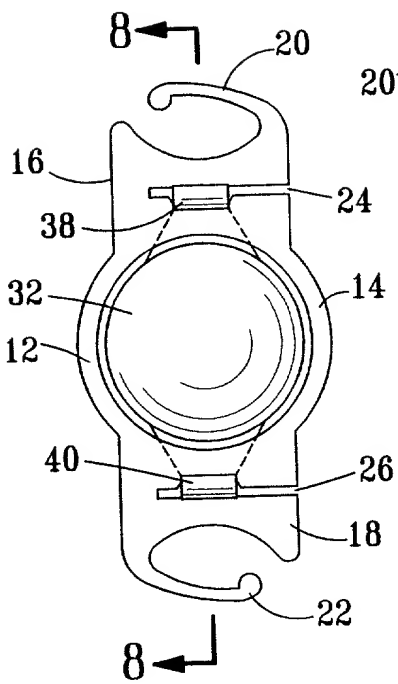

FIG. 7

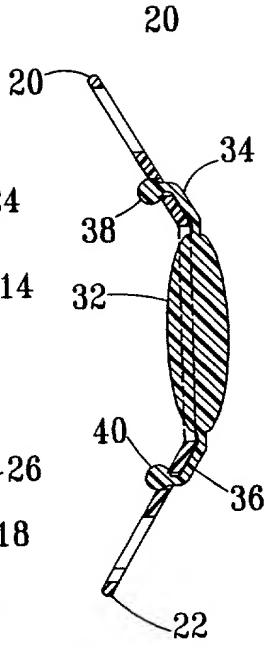

FIG. 8

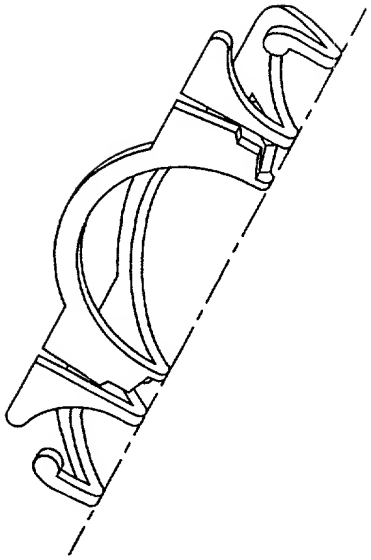

FIG. 12

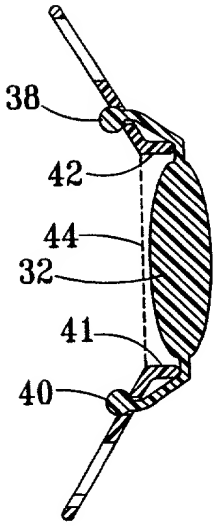

FIG. 9

FIG. 10

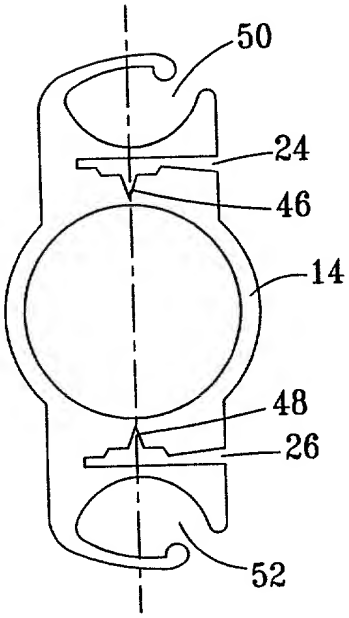

FIG. 11

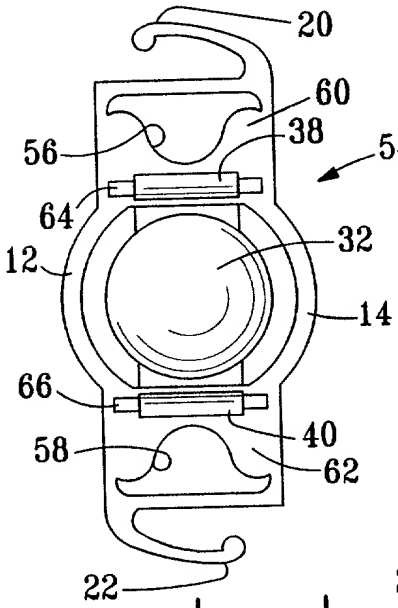

FIG. 13

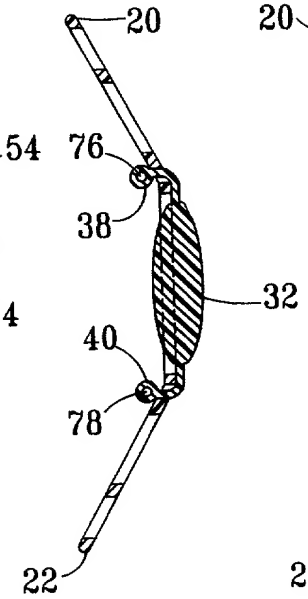

FIG. 14

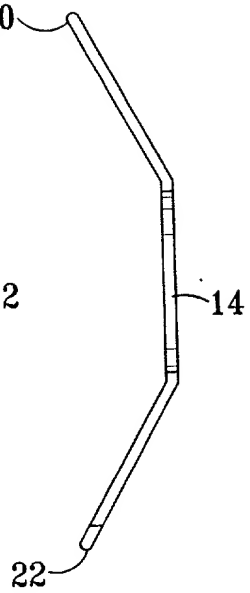

FIG. 15

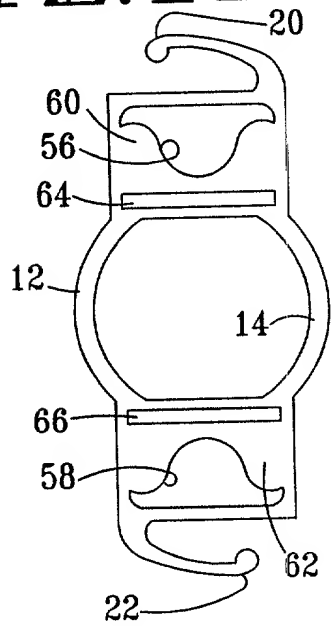

FIG. 16

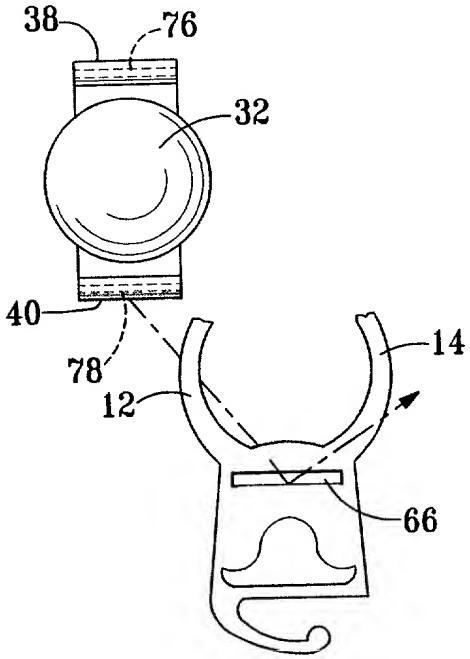

FIG. 17

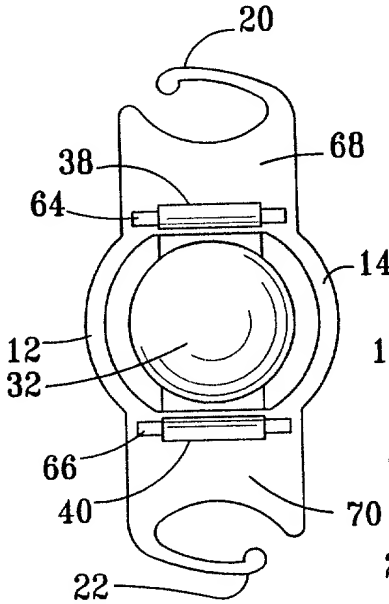

FIG. 18

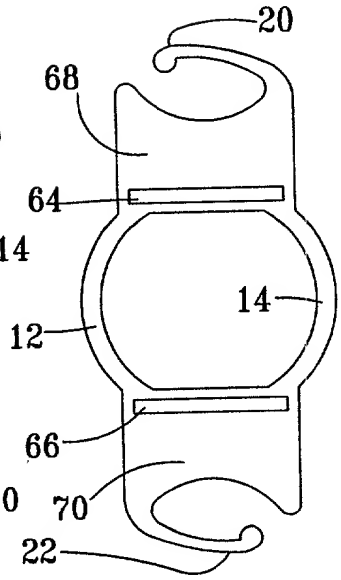

FIG. 19

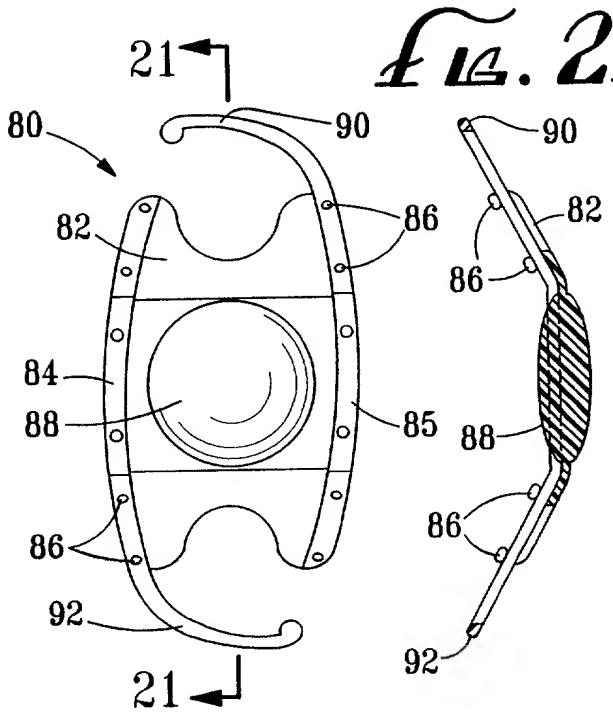

FIG. 20

FIG. 21

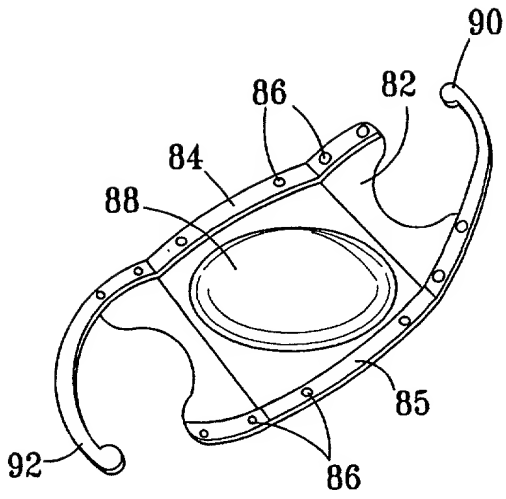

FIG. 22

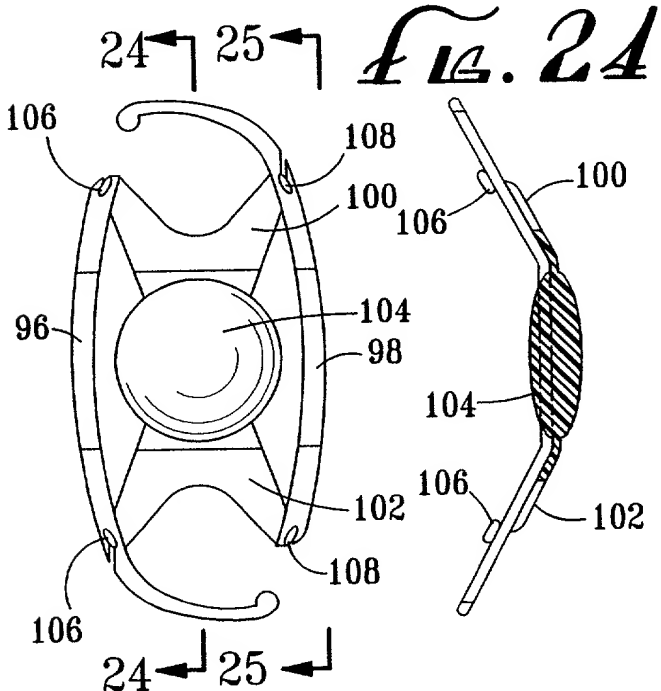

FIG. 23

FIG. 24

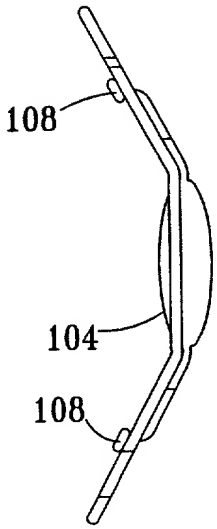

FIG. 25

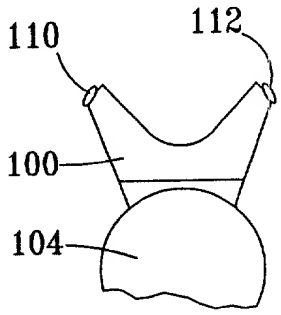

FIG. 26

DECLARATION FOR PATENT APPLICATION File No. 5891

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled LENS ASSEMBLY FOR DEPTH OF FOCUS, the specification of which is attached hereto unless the following box is checked: ☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR Sec. 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. Sec. 119(a)-(d) or Sec. 365(b) of any foreign application(s) for patent or inventor's certificate, or Sec. 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or Inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Not Claimed
(Application No.)	(Country)	(Day/Month/Year Filed)	( )
(Application No.)	(Country)	(Day/Month/Year Filed)	( )

I hereby claim the benefit under 35 U.S.C. Sec. 120 of any United States application(s), or Sec. 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Sec. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR Sec. 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application No.)	(Filing Date)	(Status: patented, pending, abandoned)
(Application No.)	(Filing Date)	(Status: patented, pending, abandoned)

DECLARATION FOR PATENT APPLICATION - cont'd. File No. 5891

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below:

_____ _____
(Application No.) (Filing Date)

_____ _____
(Application No.) (Filing Date)

POWER OF ATTORNEY: I hereby appoint the following attorney to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Boniard I. Brown, - Regis. No. 17,940. Address all telephone calls to Boniard I. Brown at telephone no. 626-338-0100. Address all correspondence to Boniard I. Brown
1500 West Covina Parkway, #113
West Covina, CA 91790-2793

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Sec. 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor:
(given name, family name) J. Stuart Cumming

Inventor's signature J Stuart Cumming Date 5/17/00
Residence Laguna Beach, California Citizenship United States
Post Office Address 1407 Emerald Bay
Laguna Beach, California 92651

( ) Additional inventors are being named on separately numbered sheets attached hereto.